RESEARCH AND IMPROVEMENT OF A STAKING MACHINE FOR PROCESSING ELASTIC-VISCOUS FIBROUS MATERIALS

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Abstract: An improved design of a technological machine was developed for staking various elastic-viscous fibrous materials, such as leather, leather fabrics, fur skins, and other materials. A machine for staking elastic-viscous fibrous materials consists of a frame, on a shaft of which a cast-iron drum with flat steel knives on radial grooves is installed using bearings; the knives are arranged in a semi-circular contour. In operating a technological machine, first, the skin is installed on a support belt and is put behind the working knives. Then the pedal is pressed and using the lever the skin is lifted on the table belt. The material being processed is in contact with the knife blades in turn, and the operator pulls the skin and stakes it. In this manner, the operator repeats the procedure and the entire area of the skin is staked. When the pedal is released, the elastic belt lowers to its original position due to the gravity and pressing force of springs. The elastic conveyor belt is periodically moved and fixed with a stopper with two bolts. When one blade of the knife is worn out, the rotation of the drum is stopped and two bolts of the knife clamp are unscrewed, and then the blade is turned over and the worn-out end of the blade is inserted into the drum, tightened with two bolts and the knife is fixed. By making elastic movable support in the form of a conveyor belt, its service life can be highly increased and the replacement time reduced. This improves the quality of leather staking and increases the yield area, and processing productivity. The technical and economic result of the use of an improved machine is an increase in the productivity and quality of leather processing, skin yield in terms of usable area, and an increase in the service life of the elastic movable support and working knives. The authors developed designs for working knives with wavy blades. Working knives are made with alternating waves on the blade, for example with two and three waves. Theoretically, a 1.1 times increase in the stress values between the processed material and wavy working knives was determined. Preliminary experiments were performed using wave-shaped knives. It was determined that due to the use of wavy knives, additional bending and stretching of the leather fabric of the skin occurs. This led to additional delamination between the fibers of the skin's leather fabric. Consequently, an increase of more than 5.7 percent in the plasticity of the treated inner side of the skin fabric was achieved.

Key words: staking machine, fur skin, drum, working knife, elastic base, stretching.

1. INTRODUCTION

Today, the leather and fur industry is dynamically developing worldwide. New technological machines are being created for the mechanical processing of leather and fur raw materials and the designs of existing technological processing machines are being improved. We have studied various technological roller machines used nowadays for the mechanical processing of raw hides [1, 2].

Based on an analysis of the operation of these machines, we have identified some shortcomings in their design. New technical solutions were developed to improve the design of roller squeezing machines and other technological machines [3–5]. The executive and working mechanisms of roller squeezing machines were theoretically studied in [6–8]. Experimental options of a roller-type squeezing machine were manufactured and experiments were conducted to increase the productivity of the technological process of squeezing excess fluid from multi-layer wet leather and certain results were obtained [9, 10]. We also theoretically and experimentally investigated the parameters, features, and physical and mechanical properties of leather, using a specific type and weight of raw material as an example [11–13].

The study in [14] examines the compression of soft fabric, considering various values of the strength and deformation modulus. The test results and numerical simulation took into account the surface settlement of the web and the pore water pressure at different processing periods and confirmed the processing efficiency of the soft web.

In [15], a double roller forced feeding device for fiber extruders was proposed. Continuous operation of the device was achieved and, accordingly, the productivity of fiber processing was increased.

In [16], a vertical high-speed twin-roll machine with steel and copper rolls was studied. In the technological process of casting aluminum alloys, copper rolls were characterized by higher velocity, rapid solidification of the strip, and high productivity compared to steel rolls.

In this study, the authors attempted to improve the technological machine designed for another technological operation and other raw materials, namely for staking the leather fabric of fur skins. To do this, we have studied and analyzed the existing designs of staking machines for processing fur skins. We considered some features found in the design of well-known staking machines. For example, we considered a very popular RM-2M (Russia) drum staker of non-through type. In the production of leather and fur, an RM-2M (Russia) drum staking machine of a non-through type is used, designed for staking and snuffing the leather fabric of fur sheepskins and medium-sized skins (astrakhan fur, merlushka lamb skin) [1, 2].

The working tools of the RM-2M (Russia) machine are flat steel knives, rigidly fixed in the radial grooves of a cylindrical cast-iron drum, the shaft of which rotates in bearings mounted on the machine frame. The working edge of the knife has a semicircular contour; knife sharpening is single-sided. The quality of staking leather fabric depends on the stability of the properties of the knife blade and the movable elastic support.

A table is used for stacking and setting skins, in the middle part of which there is a longitudinal cutout, in which a movable elastic support is placed, made in the form of a felt belt protected by leather [1, 2].

A significant disadvantage of staking machines of this type is the relatively low level of quality of knives due to the need for their repeated sharpening in tanneries and fur factories, and the low resource of the movable elastic support.

Consequently, to eliminate and improve the design of the considered staking machine, we have developed and patented a new technical solution to improve the executive and working elements of this technological machine [17].

We have developed and offered an improved technological machine for staking the leather fabric of fur skins. This machine belongs to the type of machines used in the leather and fur industry, in particular, for staking the leather fabric of fur skins.

2. MATERIALS AND METHODS

Our task concerning the proposed development was to improve the movable elastic support belt and knife.

The technical and economic result of the use of an improved staking machine is an increase in the productivity and quality of processing of skins and their yield by area and longer service life of the movable elastic supports and knives.

The main distinctive technical features of the improved staking machine are:

a) a roller is installed on the front end of the table groove;

b) a roller is installed at the end of the table;

c) a roller is installed from below in the area of the end of the table;

d) flexible elastic support is a belt in the form of an endless conveyor resting on three rollers;

e) the lower roller is movable, with springs at the ends and their other ends are fixed to the frame.

f) the lifting mechanism consists of an arch mounted on a tie rod and connected to the arch lifting rod, and the lower part of the conveyor is inside the turned U-shaped rod.

g) there is a second blade on the opposite end of the knife.

The improved staking machine is illustrated by figures. Fig. 1 shows a side view of the staking machine.

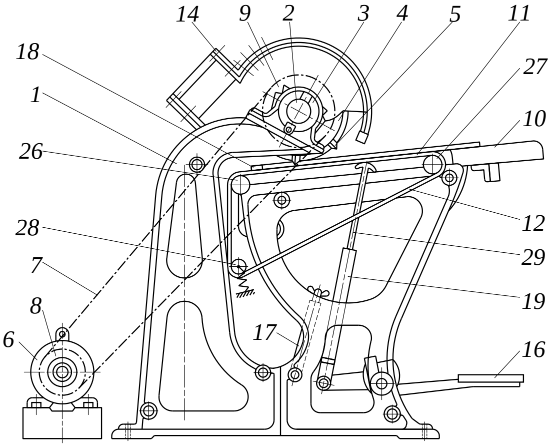

Fig. 1. Scheme of an improved drum staking machine

Fig. 2 shows a side view of a conveyor belt supported by three rollers. Fig. 3 shows the *B–B* section of the lifting rod of the upper part of the conveyor belt with skins. Fig. 4 shows a knife with two blades and Fig. 5 shows the knife in the *A–A* section.

A machine for staking leather fabrics and fur skins (Fig. 1) consists of frame 1, on shaft 2, on which a cast iron drum 4 is installed with bearing 3 with flat steel knives 5 on radial grooves of a semicircular contour of knives 5.

Electric motor 6 with belt 7 connects pulley 8 with pulley 9 on cast iron drum 4. On frame 1, there is table 10 with cutout 11, on which elastic belt 12 is attached. The working tools of the machine are flat steel knives 5, rigidly fixed in the radial grooves of cylindrical cast iron drum 4; its shaft rotates in bearings 3 mounted on frame 1 of the machine. Fig. 2 shows rollers 26 and 27 at the ends of table 10. Drum 4 has folding safety shield 13 in the front part, and in the rear part, there is pipe 14 for sucking dust from the working area of the machine.

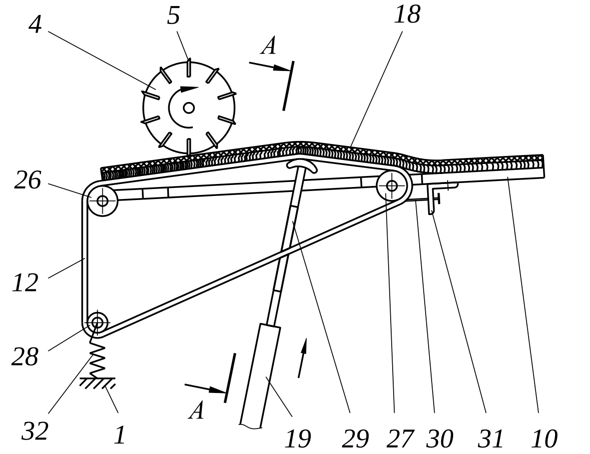

Fig. 2. Scheme of the conveying device of a drum staking machine

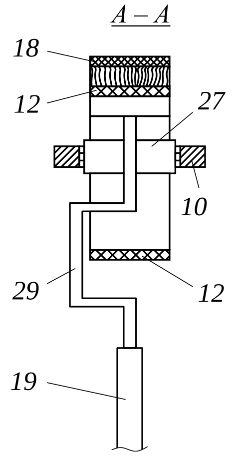

Fig. 3. Scheme of the working position of the mechanisms of the conveying device and the processed material on the staking machine

Knife drum 4 rotates from electric motor 6 through *V*-belt drive 7. Table 10 is used for setting and straightening skins 18. Moreover, in the middle part of table 10, there is a longitudinal cutout in which a movable elastic support in the form of belt 12 is placed. In the front part of the end groove of table 10 roller 27 is installed; roller 26 is installed at the rear end of table 10.

Roller 28 is installed below roller 26. Rollers 26, 27, 28 are enveloped by a movable elastic support in the form of belt 12. The front part of belt 12 goes around roller 27 in the front part of the cutout of table 10, and the back part goes around roller 26 through the top of table 10 and further below bends around roller 28. One ends of the springs are fixed to the axles of roller 28, and the other ends are fixed to frame 1. Fig. 3 shows skin 18 located on an elastic support, pressed against knives 5 of rotating drum 4 using lever device 19 with rod 29 moving elastic support 12 in the form of a belt upward when the operator presses foot pedal 16. The links of lever device 19 and belt 12 return to their original position by springs 33 and 34 when pedal 16 is released. Fig. 4 shows working knife 5, which has a semicircular contour at both ends, the knife has single-sided sharpening. Fig. 5 shows cross-section *B–B* of a knife with two blades.

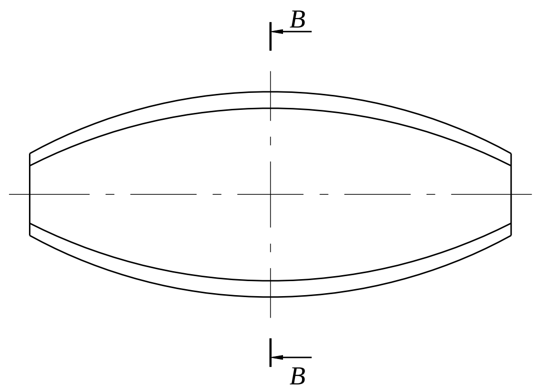

Fig. 4. Option of an improved working knife for a staking machine *B–B*

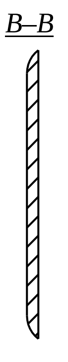

Fig. 5. Cross-section of a working knife with two blades *B–B*

The staking machine operates as follows: Belt 12 is pre-fixed with bolts 30 on angle bar 31 to prevent longitudinal displacement. Angle bar 31 is fixed to table 10 from below with screws in the area of roller 27.
When electric motor 6 is turned on, through belt drive 7, rotation is transmitted to drum 4, on which ten knives 5 are installed in grooves and each knife is secured with two bolts. The skin is placed backside and put behind knife 5. Then pedal 16 is pressed and lever 19 lifts skin 18 on belt 12 of table 10. Then, gradually, the service operator pulls the skin towards himself and, due to the contact of the leather fabric of skin 18 with the blades of knife 5, performs the staking process. This procedure is repeated and the entire area of the skin is staked. When the pedal is released, belt 12 lowers the elastic belt to its original position due to the gravity and compression force of the springs. The elastic conveyor belt is periodically moved and secured with a stopper by two bolts to eliminate its wear.
A significant disadvantage of the staking machine [1, 2] is its relatively low productivity and low quality of staking fur skins.
Consequently, we offer new options of working knives with a working edge of a semicircular wave-like contour and sinusoidal shape. Since there are ten knives on the drum, the following options for their arrangement are offered (in pairs):
a) making sinusoid-shaped protrusions and grooves on the sharpened parts of the knife blades;
b) making alternating sinusoidal wavy protrusions and grooves on the knife blades offset by a certain angle relative to the previous knife;
c) making protrusions on the blades of knives in the form of alternating segments;
d) making protrusions on the blades of knives in the form of offset segments of a circle.
When using these knife options, the productivity and quality of processing of skins, and their yield by area, increase.
The technical solution proposed is illustrated by the following drawings: Fig. 6 shows a scheme of a knife with alternating sinusoidal projections and grooves. Fig. 7 shows a diagram of a knife with alternating sinusoidal protrusions and grooves with a symmetrical offset at a certain angle relative to the dotted line *O*.
Thus, due to the installation of protrusions and grooves of the knives with alternating offset angles, when staking the skin, it is not only stretched in three directions, but additional sections of it are bent and straightened due to the blades of the knives falling into the grooves (Fig. 8).

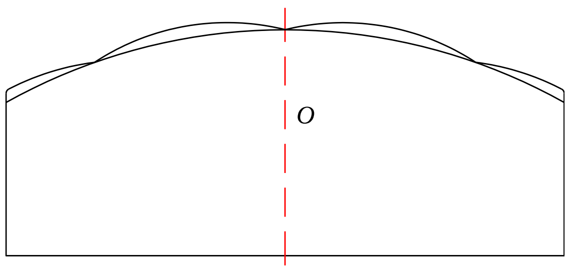

Fig. 6. Scheme of a knife with sinusoidal protrusions and grooves: first option

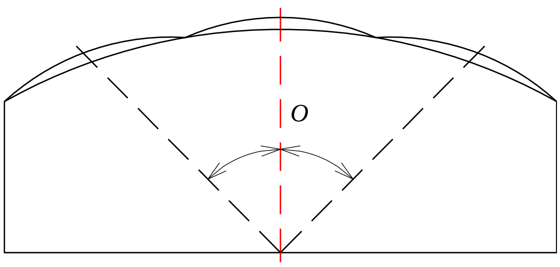

Fig. 7. Scheme of a knife with alternating sinusoidal protrusions and grooves: second option

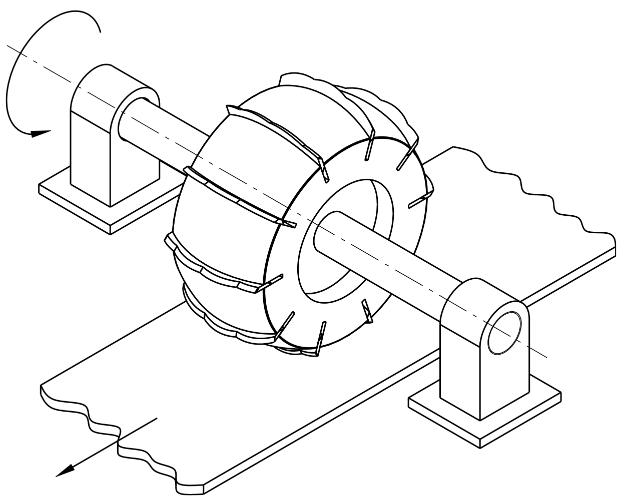

Fig. 8. Scheme of a drum of a staking machine with alternating knives with offset protrusions and grooves

Due to the offset of protrusions and grooves of the second knife relative to the first one, additional bending and straightening of skin sections falling between the knives occur. This improves the quality of skin staking and increases the yield area and processing productivity.
Now let us consider in detail the process of staking the leather fabric of a fur skin [1, 2].
It is known from literature sources [1, 2] that the knife of a staking machine, pressed to the skin with force *N*, creates tensile force *P* acting on a strip of leather fabric b = 106 mm wide (equal to the width of the knife) and δ thick. Thus, the knife creates tensile stress in the leather fabric, which should not exceed its tensile strength $[\sigma]$ (Fig. 9):

$$\sigma = P / b\delta < [\sigma] \tag{1}$$

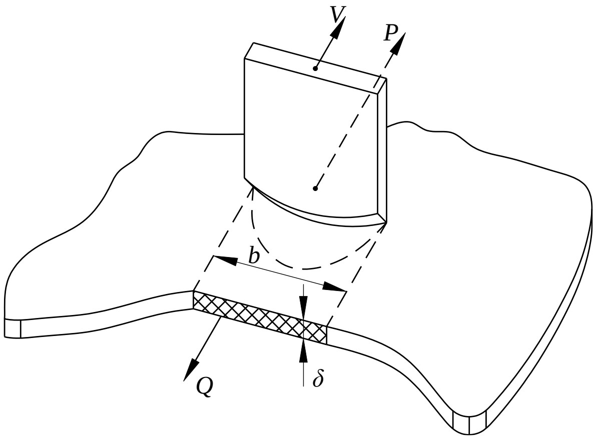

Fig. 9. Scheme of forces acting on skin staking with the conventional working knife on a staking machine [1, 2]

In addition, the skin is subject to the friction force μN against the pressing belt, mainly under the knife action and the force of the operator *Q* holding the skin being processed. Thus, these two forces balance the circumferential force *P* applied to the skin from the side of the knife:

$$P = Q + \mu N \tag{2}$$

The following relationship between the pressing force and the circumferential force is known [2]:

$$P = BN + P_0 \tag{3}$$

where *B* is the coefficient of complex resistance to the knife movement, considering friction and deformation of the material due to the contact with the knife (depending on the properties of the leather fabric and the sharpness of the knife); P_0 is the force spent on snuffing the skin of the fabric – removing the remnants of the flesh (it does not depend on the pressing force and in average is 40...60 N).
The pressing device of the staking machine is a flexible belt fixed in the table slot at one end *B* (Fig. 11), the other end is tightened by a spring with tension *T*. When the operator presses the pedal, the belt bends, its contour takes the shape of a broken line ΔCDB (Fig. 10).

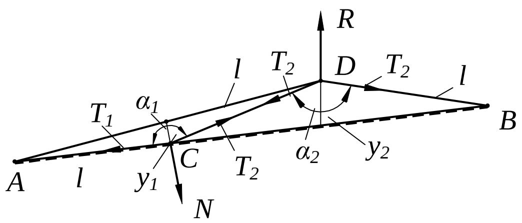

Fig. 10. Scheme of forces acting on the pressing mechanism of the staking machine

From the condition of equilibrium of forces at the inflection points *C* on the knife and *D* on the stop of the pressing mechanism, we determine

$$N = 2T\cos\frac{\alpha_1}{2} \tag{4}$$

$$R = 2T\cos\frac{\alpha_2}{2}$$

Taking approximately $T=T_1=T_2$ from ΔACD and ΔCDB, we obtain [21–25]:

$$\cos\frac{\alpha_1}{2}=\frac{y_1}{2} \tag{5}$$

$$\cos\frac{\alpha_2}{2}=\frac{y_2}{2}$$

Thus, from formulas (4) and (5), we can determine under the given pressing force the required belt tension created by the spring, force R acting on the stop, and force G acting on the pedal:

$$G=R\frac{a}{b} \tag{6}$$

where a, b are the lengths of the operating pedal levers (a=16 cm, b=32 cm).
By substituting equation (4) into equation (3), we can determine the tensile force [23–26]:

$$P=2BT\cos\frac{\alpha_1}{2}+P_0\,. \tag{7}$$

Substituting equation (7) into equation (1), we determine the tension created between the blade of the working knife and the surface of the leather fabric of the hide:

$$\sigma=\frac{2BT\cos\frac{\alpha_1}{2}+P_0}{b\delta} \tag{8}$$

The working drum of the improved staking machine contains ten knives with alternating numbers of waves (two and three waves) on the cutting edge.

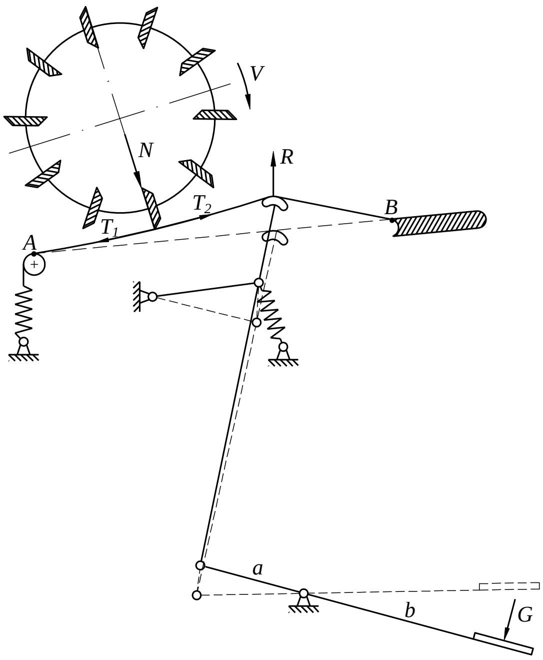

Fig. 11. Scheme of interaction of the knife of the staking machine with leather fabric

Therefore, to facilitate the calculation, it is appropriate to study these knives separately.
Let us build schemes for calculating the process of staking the treated material (Figs. 10, 11, 12) [1, 2, 18–21].

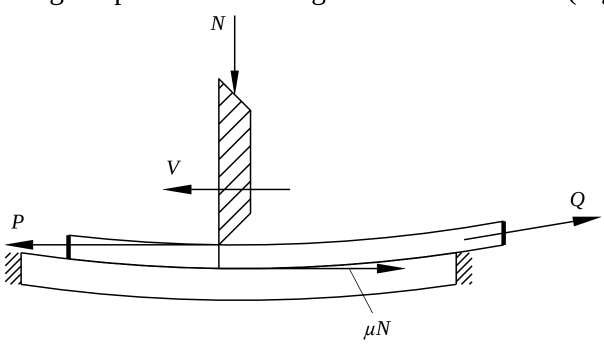

Fig. 12. Scheme of the forces acting on the skin by a working knife (with a double blade)

First, we consider working knives with two waves on the blade (Fig. 13).

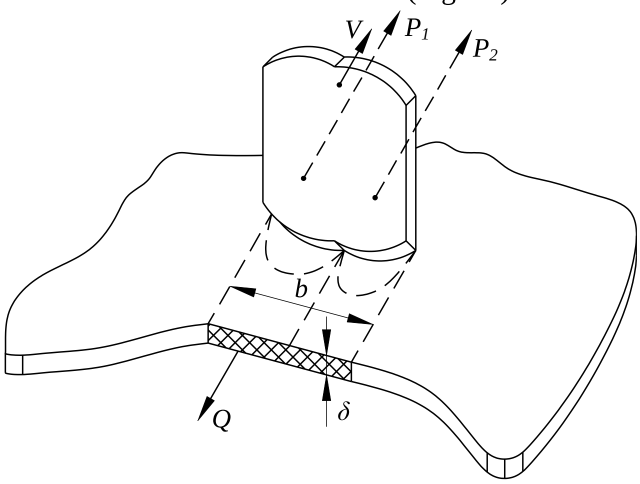

Fig. 13. Scheme of forces acting on the skin by a sinusoidal working knife with wavy protrusions and grooves: first option

Here, as in the existing analog of the knife, but with two sinusoidal waves on the blade (the first option) of the proposed working knife of the staking machine, pressed against the hide by forces N_1 and N_2, tensile forces P_1 and P_2 (at the points of contact) occur that act on the strip of leather fabric b=106 mm wide, equal to the width of the knife, and δ thick [27–33]. Here too, the knife forms tensile stresses in the leather fabric, which should not exceed its tensile strength [σ].

$$\sigma_1 = \frac{P_1}{\frac{1}{5} b\delta} \quad (9)$$

$$\sigma_2 = \frac{P_2}{\frac{1}{5} b\delta} \quad (10)$$

Adding stresses (9) and (10), we obtain the total stress as:

$$\sigma = 5 \cdot \frac{P_1 + P_2}{b\delta} < [\sigma] \quad (11)$$

here [σ] is the tensile strength of the leather fabric of the skin.

Similarly, the skin is subject to friction forces μN_1 and μN_2, against the pressing belt, mainly under the knife action and the force of the operator Q holding the processed skin [34–37]. Thus, the circumferential forces P_1 and P_2, applied to the skin from the side of the knife are balanced in this case by three forces:

$$P_1 + P_2 = Q + \mu_1 N_1 + \mu_2 N_2 \quad (12)$$

From engineering and technological considerations, the following relationship can be stated between the pressing force and the circumferential force for a knife with two waves on the blade:

$$P_1 + P_2 = B(N_1 + N_2) + P_0 \quad (13)$$

where B is the coefficient of complex resistance to movement of the knife, considering friction and deformation of the material from the contact with the knife (depending on the properties of the leather fabric and the sharpness of the knife); P_0 is the force spent on snuffing the skin of the fabric - removing the remnants of the flesh (it does not depend on the pressing force and in average is 40...60 N); P_1 and P_2 are the circumferential forces applied to the skin from the side of the knife; N_1 and N_2 are the pressing forces applied to the skin.

When the operator presses the pedal, the belt bends and its contour takes the shape of a broken line ΔCDB [38–41]. From the condition of equilibrium of forces at inflection points C on the knife and D on the stop, we obtain:

$$N_1 + N_2 = 2T \cos\frac{\alpha_1}{2} \quad (14)$$

$$R = 2T \cos\frac{\alpha_2}{2}$$

assuming approximately that T=T_1=T_2.

From triangles AOC and MDB, we calculate the cosines of angles $\alpha_1/2$ and $\alpha_2/2$ in Fig. 14 [18–20]:

$$\cos\frac{\alpha_1}{2} = y_1 / 2 \tag{15}$$

$$\cos\frac{\alpha_2}{2} = y_2 / 2 \tag{16}$$

here y_1 and y_2 are the offsets of the support belt at points *O* and *D*, respectively.

Fig. 14. Calculation of the offset of characteristic points on the support belt when the knife contacts the surface of the leather fabric of the skin (*a*) and when the rod and support belt contact from below (*b*)

Substituting equation (14) into equation (13), we obtain the following relation:

$$P_1 + P_2 = 2BT\cos\frac{\alpha_1}{2} + P_0 \tag{17}$$

Substituting equation (17) into equation (11), we obtain the stress formed by a working knife with two waves on the blade.

$$\sigma = 10 \cdot \frac{BT\cos\frac{\alpha_1}{2}}{b\delta} + 5\frac{P_0}{b\delta} \tag{18}$$

Now, we calculate a working knife with three waves on the blade (Fig. 15).

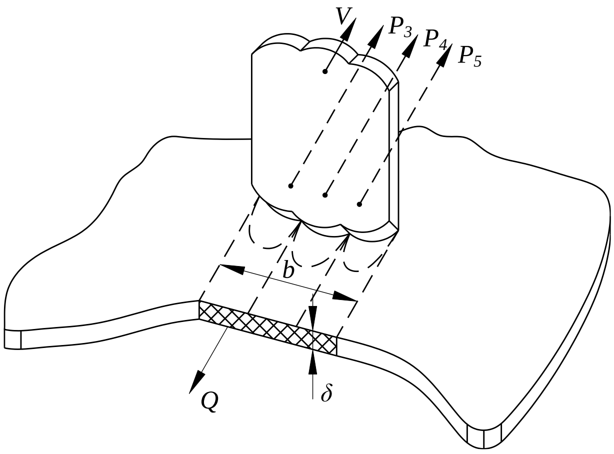

Fig. 15. Scheme of forces acting on the skin by a knife blade with alternating wavy protrusions and grooves offset by a certain angle relative to the first option of the knife (a second option)

Here, as in the well-known analog of the knife, but with three sinusoidal waves on the blade of the second option of the proposed working knife of the staking machine, pressed to the skin by forces N_3, N_4 and N_5, tensile forces P_3, P_4 and P_5 (at the points of contact) occur, acting on the strip of leather fabric of width b=106 mm, equal to the width of the knife, and thickness δ. Here also, the knife must create tensile stresses in the leather fabric, which should not exceed its tensile strength [σ] (Fig. 15):

$$\sigma_3 = \frac{P_3}{\frac{1}{5}b\delta} \tag{19}$$

$$\sigma_4 = \frac{P_4}{\frac{1}{5}b\delta} \tag{20}$$

$$\sigma_5 = \frac{P_5}{\frac{1}{5}b\delta} \tag{21}$$

Adding stresses (19), (20) and (21), we obtain the total stress created by a working knife with three waves on the blade:

$$\sigma = 5 \cdot \frac{P_3 + P_4 + P_5}{b\delta} < [\sigma] \quad (22)$$

Here, as in the previous case, the skin is subject to friction forces on the pressing belt μN_1, μN_2 and μN_3, mainly under the knife action, and the force of the operator Q holding the processed skin. Thus, the circumferential forces P_3, P_4 and P_5, applied to the skin from the side of the knife, are balanced in this case by three forces:

$$P_3 + P_4 + P_5 = Q + \mu N_1 + \mu N_2 + \mu N_3 \quad (23)$$

Accordingly, from engineering and technological considerations, the following relationship can be stated between the pressing force and the circumferential force for a knife with three waves on the blade:

$$P_3 + P_4 + P_5 = B(N_1 + N_2 + N_3) + P_0 \quad (24)$$

where B is the coefficient of complex resistance to knife movement, considering friction and deformation of the material from contact with the knife (depending on the properties of the leather fabric and the sharpness of the knife); P_0 is the force spent on snuffing the leather fabric - removing the remnants of the flesh (it does not depend on the pressing force and in average is 40...60 N); P_3, P_4, P_5 are the circumferential forces applied to the skin from the side of the knife; N_1, N_2, N_3 are the pressing forces applied to the skin.

3. RESULTS AND DISCUSSION

Thus, from formula (24) the permissible pressing force can be found based on the strength of the leather fabric (1).

When the operator presses the pedal, the belt bends and its contour takes the shape of a broken line ΔCDB. From the condition of equilibrium of forces at inflection points C on the knife and D on the stop, we obtain:

$$N_3 + N_4 + N_5 = 2T \cos\frac{\alpha_1}{2}, \quad (25)$$

$$R = 2T \cos\frac{\alpha_2}{2} \quad (26)$$

Substituting equation (25) into equation (24), we obtain the following relation:

$$P_3 + P_4 + P_5 = 2BT \cos\frac{\alpha_1}{2} \quad (27)$$

Substituting equation (27) into equation (22), we obtain the stress created by a working knife with three waves on the blade:

$$\sigma = 10 \cdot \frac{BT \cos\frac{\alpha_1}{2}}{b\delta} \quad (28)$$

Consequently, the overall stress created between the wavy blades of the working knives and the leather fabric of the skin has the following form:

$$\sigma = 20 \cdot \frac{BT \cos\frac{\alpha_1}{2}}{b\delta}. \quad (29)$$

To compare the proposed (Fig. 9) and known (Figs. 13, 15) working knives of drum staking machines, we plot the graph for B=0.9, T=20 N, δ=1 mm, P_0=50 N, b=106 mm using the Maple 2018 calculation and graphic software.

From the graph in Fig. 16, it is clear that as a result of the interaction between the working knife and the leather fabric of the fur skin, the magnitude of the created stress σ depends on the change in the angle α1 between the positions of the support belt in its initial and working conditions. Arbitrary values of this angle are less than the permissible strength limit of the leather fabric of the fur skin.

It is known that the staking machine is used for the mechanical processing of leather fabric of fur pelts by repeatedly bending and stretching it while simultaneously cleaning the surface with working knives. As a result of the technological process of staking, the required elastoplastic properties of the leather fabric are finally formed, and the inner side of the skin becomes smooth [2]. To substantiate the performance of wavy knives, the authors conducted preliminary experiments on a staking machine (Figures 17, 18).

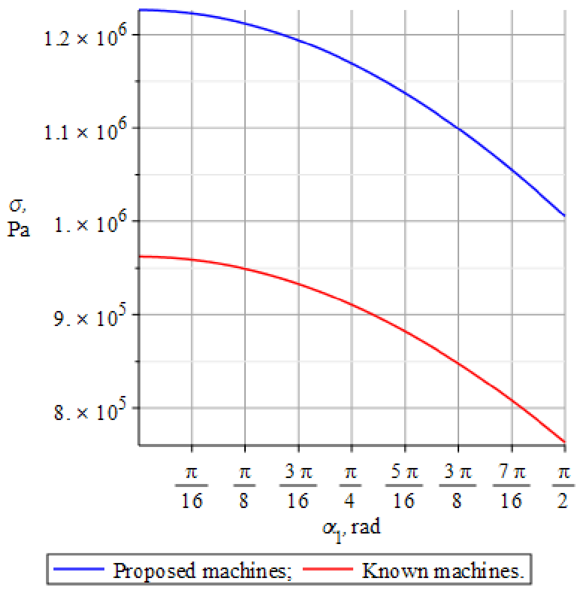

Fig. 16. Graph of the dependence of the tensile strength of the leather fabric of the processed skin σ on the change in the angle of location α_1 (in working condition) of the support belt

Fig. 17. General view of the proposed working drum of a staking machine for processing leather fabric of the fur skin

Fig. 18. The process of staking the sheepskin (grain face)

The table 1 shows experimental data on changes in the deformation properties of sheepskin as a result of staking.

Table 1. Experimental values of the deformation properties of sheepskin as a result of staking, [2]

Index	Before staking	After staking	
		with existing knives	with wavy knives (recommended)
Modulus, MPa:			
of instantaneous elasticity E_{ins}	136.3	36.4	30.25
of high elasticity E_{hig}	66.8	24.6	20.7
of elasticity equilibrium E_{eq}	44.7	14.7	11.05
Viscosity coefficient, MPa s:			
of plasticity η	0.89	1.58	1.67

Knife arrangement in this way increases the efficiency of the process of staking the leather fabric of the fur skin [26–33].

4. CONCLUSION

Thus, the design of a technological machine for staking the leather fabric of fur skins was investigated and improved; it contains a frame on which a drum is installed with knives fixed in its grooves. The rotation of the drum is performed by a belt drive of an electric motor mounted on the frame.

The conveying table has a cutout on the frame. At the front end of the table cutout there is a roller installed and fixed to the table, and at the rear end of the table there is a roller installed and fixed; under the table in its rear end a movable roller is installed on trunnions, with one ends secured by the springs, and the other ends secured to the frame.

These three rollers are enveloped by an elastic flexible belt as a movable elastic support, which can be moved up and down using levers by pressing the pedal.

The skin is placed on the elastic flexible belt backside. When the knife operates, the belt as a movable elastic support is fixed by a locking device in the form of two bolts located on the thread in two angle bars fixed under the table in the front zone. The lifting mechanism consists of an arcuate arch that contacts the upper part of the conveyor belt, mounted on an inclined U-shaped rod and bends around the lower part of the conveyor mounted on the rod lever. Knives with blades at both ends are attached alternately to the grooves of the drum.

It should be noted that under gradual use and wear of one blade of knife 5, the rotation of drum 4 is stopped and two bolts of knife clamp 5 are unscrewed, and then the worn end is turned over and inserted into drum 4 and tightened with two bolts and the knife is fixed. This improves the quality of processing. Besides, by making movable elastic support in the form of conveyor belt 12, it is possible to increase their service life and reduce the time of their replacement (Fig. 1).

All this improves the quality of skin staking and increases the yield area and processing productivity. The cost of the knife is lower due to the presence of two blades and metal consumption is reduced by approximately 200 percent.

The results of the study show that the stress generated when using improved working knives on a staking machine is greater compared to using conventional knives.

Therefore, the greater the stress created, the greater the tensile force. Thus, high force means that the short-time impact is sufficient according to the law of conservation of momentum.

This leads to an increase in the efficiency of the impact of wave-shaped working knives on the leather fabric of the fur skin and, accordingly, lowers energy consumption by reducing the processing time during the technological process.

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